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Protein and Energy Requirements of Replacement and Feedlot Cattle[1]

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Feed and water are still the most important ingredients in a successful recovery and feeding program for replacement feedlot cattle. Oftentimes due to the feeding of unfamiliar feeds or feeding in unfamiliar places (e.g. feed bunks), cattle do not readily consume feed after they are shipped to feedlots and therefore are slow to recover weight loss during shipment and to readily start on feed. Without feed consumption, refinements in protein and energy levels are futile. We have been attempting research in this area but this is a difficult area and therefore only limited research data can be brought to bear on this important phase of feedlot production. Once cattle are on feed, more is known about their nutritional requirements and refinements are easier to make.

Protein Requirements

The most accepted nutrient requirement standard today is that published by the National Academy of Sciences (NAS-NRS, 1970). This provides an acceptable guide for meeting the nutrient requirements of beef cattle. The standards are not necessarily those that typify commercial feedlot conditions, however, and therefore their application is somewhat limited. Various other schemes have been proposed based on protein:energy ratios (Preston, 1972) and on metabolizable protein requirements and values of feedstuffs (Burroughs, et al., 1972).

Even though these schemes take into consideration several known factors that affect protein requirements, marked deviations from these standards are known to occur. This no doubt is the reason for a number of new areas of protein requirement research in ruminants (Preston, 1970). Studies are underway to determine amino acid requirements and to determine first limiting amino acids when certain rations are fed. Because of the modifying influences of the rumen on the eventual availability of protein to the ruminant, considerable research interest centers on protein and nitrogen solubility in the rumen and the potential for by-passing high quality proteins and amino acids to the lower tract by changing their solubility and availability in the rumen. Treating soybean meal and other high quality proteins with formaldehyde to reduce their catabolism in the rumen is an example of this effort.

Certain observations, however, indicate that protein requirements may deviate markedly from standard requirement values. These have been reviewed (Preston, 1973) and were the basis for several of our studies to determine if supplemental protein could be reduced or even eliminated from typical finishing rations for feedlot cattle. The detailed results of this work have been published and will only be summarized here (Preston and Cahill, 1972; Preston and Parrett, 1972; Preston and Cahill, 1973; Preston, Kock and Cahill, 1973; Preston, Kunkle and Cahill, 1974; Preston and Cahill, 1974a).

Basically corn-corn silage rations were fed to growing-finishing steers. Soybean meal or urea was the source of supplemental protein; the urea supplement contained calcium, phosphorus, potassium and sulfur equal to the amounts found in soybean meal. Likewise, when either of these sources of supplemental protein were withdrawn from the ration, a replacement supplement was fed that contained these same minerals mixed with corn.

Four experiments - two with calves and two with yearlings - indicate that supplemental protein is not required during the entire feeding period. In these experiments, if the cattle had been on feed for at least 28 days and weighed at least 750 lbs., performance and carcass characteristics were not altered by removal of supplemental protein from the ration. When protein was removed, the crude protein content

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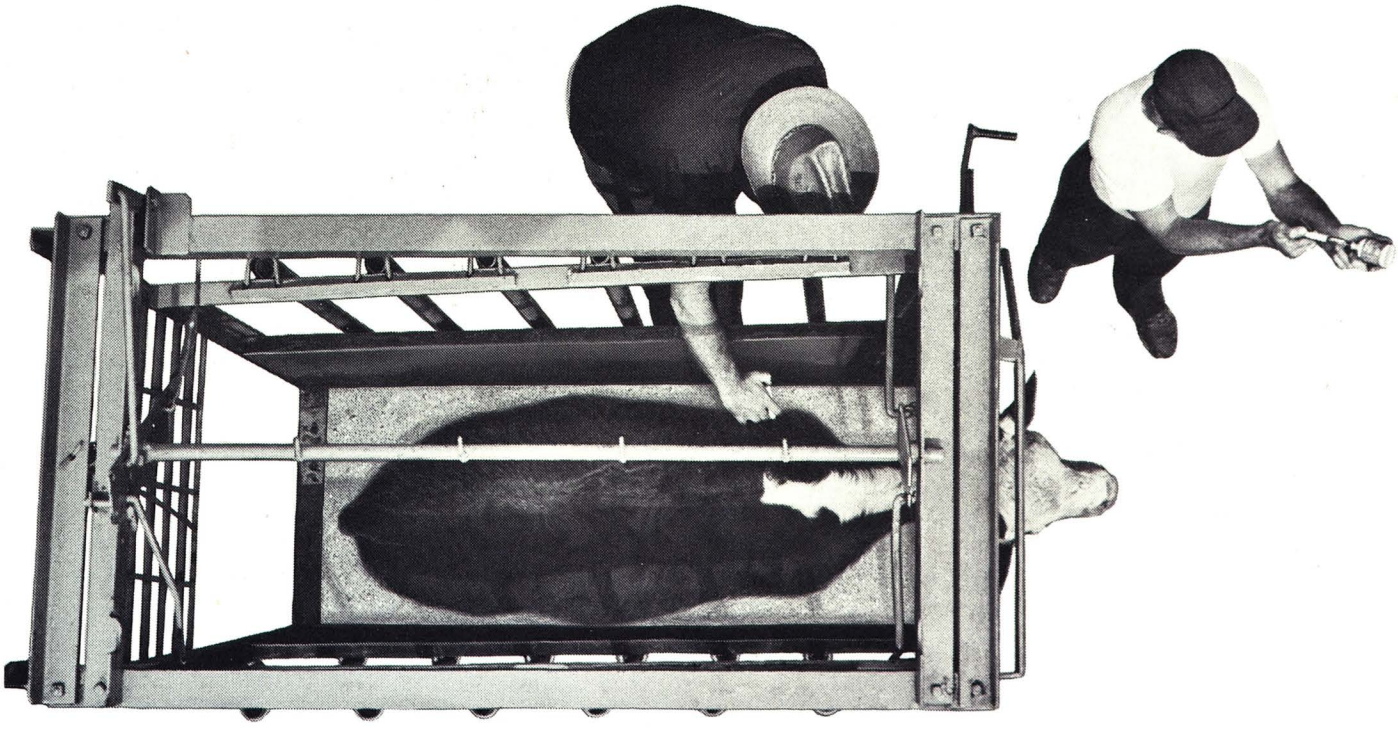

of the ration averaged 8.2 - 8.6% of the dry matter; this is considerably below the 10.5 - 11.5% which is commonly used as the protein requirement.

Results from Kentucky, Arizona, Kansas, Missouri and Wisconsin have confirmed these findings.

Certain nutrient levels appear to be critical before removal of supplemental protein will result in equal performance. An adequate level of potassium (0.7% of DM) is essential (Preston, Kunkle and Cahill, 1974; Preston and Cahill, 1974). Sulfur supplementation has been studied during supplemental protein withdrawal but basically no improvement in performance has been observed above 0.12% of DM and some tendency for reduced performance has been observed at higher levels (Preston and Cahill, 1973; Preston, Kunkle and Cahill, 1974). Purdue workers have observed a marked reduction in performance of cattle fed a protein withdrawal ration containing only 7.5% crude protein in the ration dry matter (Beeson, Perry, Thomas and Mohler, 1974). The reason for their withdrawal rations being so low in protein was an abnormally low level of protein in both corn grain (8.3% of DM) and corn silage (6.4% of DM). We have also conducted an experiment where the protein content of the corn grain was unexpectedly low (8.1 to 8.6% of DM); performance of these cattle was reduced (Preston, Cahill and Parker, 1974). Therefore, I conclude that the protein content of the ration of steers weighing 750 lbs. or more after they have been on feed should be no lower than 8.2 - 8.3% of the dry matter.

We have looked at protein levels and sources for replacement feeder cattle and generally conclude that they do not require levels higher than a standard based on protein:energy ratios (Preston, Vance and Smith, 1970); higher levels may give a temporary increase in rate of gain but when the total period is considered, no difference in performance was observed (Preston and Cahill, 1974). Light weight feeder calves can make use of urea (Preston, 1974); however performance is better when soybean meal is used as the source of protein. Feeding formaldehyde treated soybean meal during this time may permit feeding less protein (Preston and Smith, 1974). This may be a function of the transition which nursing calves must make (e.g. protein by-passing the rumen via the esophageal groove) to typical feedlot rations where protein is degraded and resynthesized into microbial protein in the rumen.

Energy Requirements

This discussion will not deal specifically with energy requirements of growing-finishing cattle but will instead deal with sources of energy. The National Academy of Sciences tables also show energy requirements (NAS-NRC, 1970) and recently the California net energy system is finding increasing application by feedlot nutritionists (Lofgreen and Garrett, 1968).

When feeder cattle are first received in the feedlot, the initial problem is to achieve adequate feed intake. Therefore, any feed which results in early acceptance and consumption by cattle is generally recommended. Hay, of average quality or less, is used as a starting feed in many feedlots. We have compared chopped grass hay with corn silage for starting feeder cattle (Preston, Smith and Kunkle, 1973; Preston and Kunkle, Preston, Kunkle and Smith, 1974). As expected, cattle started on chopped hay ate more feed and gained much faster initially; steers fed corn silage were slow to consume this feed initially and gained poorly during the first week. However, after this first week, the picture dramatically reversed and during the first 30-60 days in the feedlot, steers fed corn silage outperformed those fed chopped hay. It was also true that steers started initially on chopped hay and gradually changed to corn silage did poorly during the changeover period. Thus if corn silage was to be a major ingredient in the initial ration of feedlot cattle, we could see no advantage in starting cattle on hay; their performance was actually lower than cattle fed corn silage from the beginning.

This research pointed to a more important result, however, than just the initial performance of replacement cattle. When these cattle were changed to high concentrate finishing rations, cattle that were previously fed corn silage had better initial performance on the high concentrate ration and there was a tendency for fewer liver abscesses to occur in these cattle than in those that were fed hay initially (Preston and Cahill, 1974b; Preston, Cahill, McClure, Klosterman and Kunkle, 1974; Preston, Cahill, Kunkle and Parker, 1974).

We postulated that part of this response to corn silage was due to the presence of lactic acid in the silage. It is well known that the reason for founder and laminitis often observed in cattle placed on high concentrate rations is due to the accumulation of lactic acid in the rumen, produced by lactic acid forming bacteria, before microflora develops that can utilize this lactic acid. We developed an assay for measuring lactic acid adaptation and indeed were able to show that ruminants (sheep) fed hay with added lactic acid were able to metabolize this acid in the rumen at a rate which was three times faster than when fed hay only (Kunkle, 1974). Using this assay, we hope to be able to better define ways and feeds for starting replacement cattle on feed in the feedlot.

The feeding of high concentrate rations to feedlot cattle was primarily the result of low grain prices relative to roughage. Now with much higher grain prices, there is increasing interest in the use of roughage for feeding cattle and the possibility of producing more "grass fat beef."

In studies on the relative energy utilization of corn grain and corn silage by growing-finishing beef cattle, we have shown that more energy for gain is derived from rations that are either high in corn grain or in corn silage in contrast to rations that contain more conventional mixtures of these two feeds (Vance, Preston, Cahill and Klosterman, 1972). In other words more useful energy will be derived from silage when it is full-fed than when increasing proportions of

corn grain are fed with the silage. The immediate question that is asked is can cattle be finished on corn silage and supplement without sacrificing carcass grade.

Most research indicates that plane of nutrition does not alter body composition of cattle when evaluated at equal weight (Preston, 1971). However, we have recently completed an experiment where Angus and Charolais steers were full-fed either corn silage or a high concentrate ration to slaughter (Preston, Cahill, Bennett and Parker, 1974). As expected, steers fed corn silage gained slower than those fed the high concentrate ration (2.26 vs. 3.04 lbs./day). When the carcasses of these steers were studied, steers fed corn silage had less marbling and less total carcass fat than steers fed the high concentrate ration, even though outside fat cover (fat thickness) was not different. In the Angus calves, kidney - pelvic - heart fat was not altered by ration whereas Charolais steers fed the high concentrate ration had a significantly greater amount of kidney - pelvic - heart fat compared to Charolais steers fed the corn silage ration. All of these observations were made at equal carcass weight within each breed. Thus, silage fed cattle had less fat, less marbling, equal outside fat cover and variable internal fat, depending on breed, compared to cattle fed the high concentrate ration. Since cattle full-fed silage to 740 lbs. live weight and then finished on a high concentrate ration did not differ in their carcass characteristics compared to steers full-fed from the beginning on a high concentrate ration (Newland, Reed, Preston and Cahill, 1974), I conclude that the last 100-150 lbs. of gain prior to slaughter should result from a ration that is at least moderately high in concentrate (e.g. 70-80% concentrate) to permit cattle to reach equal grade following high roughage feeding programs.

Summary

Research reviewed in this paper indicates that a lot is still to be learned about the ruminant animal (cattle and sheep) and its nutrition. A number of new findings have not only academic interest but also considerable practical value. Supplemental protein needs during the finishing period, energy utilization of feeds fed in varying proportions and their effects on carcass composition, the adaptation response of ruminants to changes in feed are but a few examples of areas that will yield useful results to the beef producing industry.

References

1. Beeson, W. M., T. W. Perry, V. M. Thomas and M. T. Mohler. 1974. Effect of protein supplementation on the performance of steers. (Incomplete data). Annual Indiana Cattle Feeders Day Report, Purdue Univ. W. Lafayette, pg. 18. - 2. Burroughs, W., A. Trenkle and R. L. Vetter. 1972. Proposed system of evaluating protein nutrition of feedlot cattle: metabolizable protein and urea fermentation potential of feeds. Proc. 32nd Semi-annual Meeting Am. Feed Mfgs. Assoc. Nutr. Council, pg. 27. - 3. Kunkle, W. E. 1974. Evaluation of lactic acid adaptation on performance and lactic acid metabolism in cattle and sheep. Ph.D. Thesis, Ohio State Univ., Columbus. - 4. Lofgreen, G. P. and W. N. Garrett. 1968. A system for expressing net energy requirements and feed values for growing and finishing beef cattle. J. Anim. Sci. 27:793. - 5. NAS-NRC. 1970. Nutrient requirements of beef cattle. Pub. No. 1754. - 6. Newland, H. W., D. L. Reed, R. L. Preston and V. R. Cahill. 1974. Methods of feeding corn silage and shelled corn to finishing calves: II. Backgrounding on corn silage and finishing on all-concentrate diets vs. all-concentrate rations for Hereford-Charolais crossbred calves. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 37. - 7. Preston, R. L. 1970. Introductory remarks: Amino acids in ruminant nutrition. Tenth Annual Ruminant Nutr. Conf. Fed. Proc. 29:33. - 8. Preston, R. L. 1971. Effects of nutrition on the body composition of cattle and sheep. Proc. Georgia Nutr. Conf. pg. 26. - 9. Preston, R. L. 1972. Protein requirements for growing and lactating ruminants. Univ. Nottingham Nutrition Conf. for Feed Manufacturers: 6. Churchill Livingstone, Edinburgh and London. pg. 22. - 10. Preston, R. L. 1973. Supplemental protein needs of growing-finishing cattle. Proc. 33rd Semi-annual Meeting Am. Feed Mfgs. Assoc. Nutr. Council, pg. 36. - 11. Preston, R. L. 1974. Utilization of urea by light weight feeder calves. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 43. - 12. Preston, R. L., and V. R. Cahill. 1972. Source of supplemental protein and time of supplement for growing-finishing steer calves. Ohio Agr. Res. and Dev. Center, Res. Summary 63, pg. 37. - 13. Preston, R. L. and V. R. Cahill. 1973. Withdrawing supplemental soybean meal from steer calves at varying times during the finishing period and the value of supplemental amino acids, with observations on DES implant levels. Ohio Agr. Res. and Dev. Center Research Summary 68, pg. 1. - 14. Preston, R. L. and V. R. Cahill. 1974a. Protein levels and supplemental protein withdrawal as affected by roughage source and potassium supplementation in finishing steer calves. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 7. - 15. Preston, R. L. and V. R. Cahill. 1974b. Comparison between treated and untreated high moisture shelled corn with dry whole shelled corn when fed with varying levels of corn silage to growing-finishing steer calves. Ohio Agr. Res. and Dev. Center Research Summary 77, pg. 23. - 16. Preston, R. L., V. R. Cahill and C. F. Parker. 1974. Supplemental protein withdrawal in steer calves fed high concentrate rations containing adequate mineral fortification. Ohio Agr. Res. and Dev. Center, (unpublished research). - 17. Preston, R. L., V. R. Cahill, W. E. Kunkle and C. F. Parker. 1974. Role of roughage in high concentrate rations for finishing steer calves. Ohio Agr. Res. and Dev. Center, (unpublished research). - 18. Preston, R. L., V. R. Cahill, G. Bennett and C. F. Parker. 1974. Production of beef from Angus or Charolais steers full-fed either corn silage or a high concentrate ration. Ohio Agr. Res. and Dev. Center, (unpublished research). - 19. Preston, R. L., V. R. Cahill, K. E. McClure, E. W. Klosterman and W. E. Kunkle. 1974. Influence of type and level of roughage fed with dry whole shelled corn for growing-finishing steer calves. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 31. - 20. Preston, R. L. and W. E. Kunkle. 1974. Role of roughage source in the receiving ration of yearling feeder steers. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 51. - 21. Preston, R. L., S. W. Koch and V. R. Cahill. 1973. Supplemental protein needs and utilization of dry and crimped corn in yearling steers. Ohio Agr. Res. and Dev. Center Res. Summary 68, pg. 9. - 22. Preston, R. L., W. E. Kunkle and V. R. Cahill. 1974. Role of potassium and sulfur during supplemental protein withdrawal in yearling steers. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 1. - 23. Preston, R. L., W. E. Kunkle and C. K. Smith. 1974. The role of certain feeds in adapting new feeder calves to the feedlot. Ohio Agr. Res. and Dev. Center Research Summary 77, pg. 55. - 24. Preston, R. L. and N. A. Parrett. 1972. Form of grain and protein levels for yearling steers. Ohio Agr. Res. and Dev. Center Research Summary 63, pg. 75. - 25. Preston, R. L. and C. K. Smith. 1974. Role of protein level, protected soybean protein, and roughage on the performance of new feeder cattle. Ohio Agr. Res. and Dev. Center Res. Summary 77, pg. 47. - 26. Preston, R. L., C. K. Smith and W. E. Kunkle. 1973. Role of roughage source and medication in the early feedlot performance of feeder calves. Ohio Agr. Res. and Dev. Center Res. Summary 68, pg. 33. - 27. Preston, R. L., R. D. Vance and C. K. Smith. 1970. Value of protein, energy and medicated supplement for new feeder calves. Ohio Agr. Res. and Dev. Center Res. Sum-